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ABSTRACT

This paper reviews research with a focus on looking at the differences between research taken on by those who see themselves primarily as science educators/science education researchers, and those who conduct research on science education from the perspective of a particular discipline such as psychology or sociology. It is assumed that the normative aspect--the improvement of practice--is the dominant contextual background, and three issues are presented: (1) culture studies/cultural studies; (2) justified assumptions; and (3) putting the "multi" back in multicultural science education. (KHR)

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Research on Multiculturalism Applied to Students' Learning School Science: Some Theoretical Issues

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When I first started doing research in the field of multicultural science education about fifteen years ago, I felt like a lone wolf in the wilderness. The field did not exist. There were only a handful of papers that dealt with science education and culture to any extent and papers on science and culture were even rarer. As a result, a researcher was forced to extrapolate from other fields. For me these were multicultural education, cross-cultural psychology and educational anthropology; especially the latter. For researchers in the field today the picture appears quite different. Articles such as those by Hodson (1993), Pomeroy (1994) and Aikenhead (1996), while not strictly speaking review articles, provide extensive references and yet even these are not exhaustive. The existence of an extensive literature and the fact that there have now been a number of symposia at conferences, as well as the upcoming workshop at NARST which, to a large extent, is intended as a "state of the art" exercise are indications that multicultural science education can be considered a field of research.

There are other indications that a field now exists. In the beginning there was a tendency for us to be involved in multiple aspects of the field. More and more we are starting to see some specialization occuring and with it a recognition of the complexity of the field. In many ways, the development of multicultural science education paralleled the development of multicultural education, but about a decade later (Krugly-Smolska, 1997). Most important in this development, however, is the emergence of multiple perspectives and disagreements. By disagreeing with each other on specific points or approaches, we are no longer in danger of putting the whole notion of multicultural science education, or its importance, in jeopardy.

In a recent article that presents a critique of educational research (both positive and negative), Labaree (1998) makes a number of points that are relevant to our current discussions. He contends that in education intellectual workers are spread all over the terrain and that we feel free to charge off in all different directions without a great deal of concern about what stage the development of the field has attained. The clusters that develop are the result of practical needs of the institution or society's concerns about its state rather than from the internal logic of the research effort itself. Furthermore, he argues, education as an area of inquiry is a public policy field (not an intellectual discipline) whose central orientation is irreducibly normative. "It is not enough to study what is interesting about education, the researcher is under pressure to improve it" (Labaree, 1998, p. 6). In this context he also asserts that education is not a discipline because it does not have a distinctive theoretical perspective for viewing the world nor a distinctive research methodology.

While this may be considered a negative, in the field of multicultural science education, I believe it is a plus. Multiple perspectives are needed in studying complex phenomena, but, as Labaree further asserts, when researchers are free to be eclectic in intermingling disciplinary perspectives and methodologies it can lead to lax attitudes towards methodological rigor. There is a danger that one takes this "as a license to say what one wants without regard to the rules of evidence or forms of validation" (1998, p. 11).

Given the context of the development of the field of multicultural science education and education research in

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general, it would be interesting to provide a review of the research with a focus of looking at the differences (if any) between research taken on by those who see themselves primarily as science educators/science education researchers and those who conduct research on science education from the perspective of a particular discipline such as psychology or sociology. Likewise a review of the normative aspect would be an interesting undertaking.

While these are interesting issues, they are not the ones I wish to pursue in this paper in my role as idea generator. Instead, I wish to focus on three for which the aforementioned are contextual backgrounds. For the moment, I would also like to assume that the normative aspect , the improvement of practice, is the dominant one in the field. For this reason, I would like to argue about the importance of multiple voices and multiple perspectives. I will undertake this in the presentation of the three issues that I have identified for convenience under the headings: culture studies/cultural studies; justified assumptions?; and putting the 'multi' back in multicultural science education. I hope it will become evident that the three are very much interrelated; do deal with current research in multiculturalism applied to students' learning school science, the title of this paper; and have implications for the future direction(s) of research in this area.

Culture Studies/Cultural Studies

While Labaree (1998) describes education as not having a distinctive theoretical perspective, those of us in the field of multicultural science education could be described as having one in that we appear to share a common agreement that culture plays a role in science learning even though we may disagree as to what role and to what extent. Such a deduction is not necessarily justified and my distinction will, I hope, make that clear.

Borders are often maintained in cultures and academic disciplines through a number of tactics. One of the most important is language use. Science educators using English as their primary language are familiar with this situation, given the difficulty they have getting students to understand that the everyday meaning of the word 'work' is different from the scientific meaning. My inductive hypothesis is that there is a greater tendency in English to give special meaning to words which already have concepts attached to them, than is the case with other languages (though I have a relatively small sample size). Such is the case with cultural studies.

One would assume that what is meant by cultural studies is the study of culture. One would be right up to a point. First of all it is the study of culture not cultures. Cultural studies did not arise out of anthropology, although there are now cultural anthropologists approaching their work from a cultural studies perspective. Confused? Many non-initiates are. Cultural studies also illustrates border setting in its use of language. To be a member of the tribe, one must use certain key terms and codes. During (1993) provides a brief history of cultural studies. It is not my intent here to discuss this history, rather it is to describe cultural studies in order to contrast it with what we have deliberately (I believe) called culture studies.

According to During cultural studies is the study of contemporary culture, but one that is characterized by its engaged form of analysis that recognizes the unequal structure of society and unequal access to resources by all members. It has a very strong normative and political component and has sometimes been described as the study of power because of Foucault's influence on the field. Historically there were ties to Marxist theory and more recently to postmodernism. Cultural studies might be characterized as a theoretical framework (though somewhat diffuse) through which the study of various other intellectual endeavours is approached. I would further argue that the focus of cultural studies is the critique of contemporary western culture and especially the products of that culture (witness the heavy emphasis on popular culture). Even in the postcolonialism school, if I may call it that, the focus is on the role of western culture in colonial interactions. Granted it is a critical

perspective and focuses on what the west did wrong in colonized communities, but the focus, as I read it, for the most is still on the west.

Since science is a product of western culture, cultural studies also examines science, especially to question its dominance as a form of knowledge. Furthermore, there is unequal access to that form of knowledge in society. Science education then becomes a focus because it is a vehicle through which unequal access is maintained. In a multicultural context, when some cultural groups have less access than others, it is evident that a cultural studies perspective can/will be used to understand and improve the situation. Many of us in the multicultural science education field actually use the cultural studies theoretical perspective to do our work both in western and non-western contexts, for example when we challenge the hegemony (one of the code words?) of western science and western science education.

In contrast, many of the others of us take a perspective that might be grouped as culture studies. In this case the concept of culture is actually the theoretical underpinning and interpretive framework that we use for understanding much of what happens in science education. I would like to point out that the two groups are not mutually exclusive. The overlap might be understood as a Venn diagram. Those in the overlap might switch back and forth or might use the two concepts concurrently. The culture studies group may also be characterized by its focus on multiple cultures and cross-cultural interactions.

Unfortunately the theoretical framwork can be just as diffuse as in cultural studies because there is no agreement on how the concept of culture is understood and used. This may be because culture is one of those things that everyone thinks they undertand in an everyday sense of the word, yet the meanings differ, for example, among (and within, see e.g. Jenks, 1993) the humanities, sociology and anthropology. Furthermore, some researchers come at this from a cross-cultural psychology perspective, others from a cognitive anthropology perspective. Given what I've said about multiple perspectives, this is not a problem in and of itself. The problem arises when we do not know which perspective the researcher in question is using. Often those talking about culture in multicultural science education do not provide the definition of culture with which they are operating.

A further complication in this somewhat sloppy use of the concept of culture is that we have lost (with notable exceptions, see e.g. Aikenhead, 1996) the concept of sub-culture. School culture, classroom culture, gay culture, adolescent culture, science culture, class culture are all used more or less as equivalents (and I have been as guilty of this as others). By doing this we lose the important point that these sub-cultures are embedded in a broader culture. While I do not believe we will change our habits at this point, I do want to encourage us to keep the broader context in mind even as we investigate particular sub-cultures.

Those adhering to a cultural studies perspective might disagree as some postmodernists would argue that the notion of an overriding culture is meaningless (all grand narratives are put in question), however those of us who have experienced cross-cultural interactions would disagree. Post-modernists also legitimate personal experience in research. Furthermore, I do not believe that they would disagree that the classroom culture in France is different from that in Canada, although there may be similarities, given both are considered part of western culture and schools as we know them have a western heritage.

One aspect of culture that draws attention from the culture studies perspective is the notion of worldview. The characterization of some of the issues in multicultural science education in the culture studies perspective as culture conflict in worldviews may not be appropriate in all contexts. I do not believe I am being heretical when I make this statement, as I believe that the concept of worldview can be very powerful. I would, however like to introduce some subtleties. Let me elaborate in the next section

Justified assumptions?

That there is a difference in worldview between western and non-western cultures, there is no question. That this affects science teaching and learning, there is no question. The question is to what extent and how salient is worldview compared to other aspects of culture. Studies such as that by Ogunniyi, Jegede, Ogawa, Yandila and Oladele (1995) are starting to provide some answers. In that study the authors cite other studies which show that culture is an important variable in science teaching and learning. If we are going to be true to what I have characterized as culture studies, namely that we use culture as a theoretical perspective in cross-cultural contexts, we need to understand it as more than one variable. Various aspects of culture would then be understood as separate variables, worldview being one. Which ones would be most salient in which contexts would then become an important question.

Multicultural science education deals with at least three very different contexts: western science education occuring in non-western cultural context, western science education in a western context but with populations of predominantly non-western origin (for example aboriginal populations) and western science education in a western context but with populations of varied cultural origin, both western and non-western. The typology is merely a heuristic. Many of us move back and forth among these contexts both in theorizing and in researching. It is possible that in the three contexts, different aspects of culture will have greater salience. Any useful theory of the role of culture in science education would, however, be applicable to all three, as is, for example, the concept of crossing borders between cultures (Aikenhead, 1996). At this point I would like to shift my attention to the third context, which in many ways is the most complex, and through it examine some of the assumptions current in multicultural science education.

Labaree's (1998) description of educational research as mostly normative is true in the field of muticultural science education. Very few of us are in it strictly due to intellectual curiosity. Our purpose is transformational. We have seen inequities in student achievement in, and access to, science and we want to change the situation. As a result, much of the research in our field has been discursive, if not outright polemical. This is especially evident in two articles I referred to earlier, that of Hodson (1993) and Pomeroy (1994).

Pomeroy's mapping of the field is not a review of research agendas, but of transformationist agendas based on certain beliefs - what we need to do to get underrepresented minorities to participate more in the scientific endeavour. The justification for the beliefs is presented in the discussion section and largely (though not exclusively) taken from multicultural education research conducted from multiple perspectives. Likewise, in addition to presenting his rationale for the importance of multicultural science education, Hodson provides suggestions of strategies for implementation. These follow logically from his rationale and could be said to be deduced from it.

It is interesting that Pomeroy chose the word belief as the underlying justification for the transformationist agendas she discusses. I would suggest instead the word hypthesis. These hyptheses and others arise often from certain theoretical frameworks, sometimes from previous research findings, but just as often intuitively. From the history of science we have seen how intuitive hypotheses can be misleading and often disproven. For that matter so can those that arise out of theoretical frameworks. My concern is that we tend to make suggestions to teachers on how to alter their practice to meet certain goals based on hypotheses that have not been validated, and if they have, the strategies that arise from them have not. It is from these observations that my question of justified assumptions arises.

One common approach suggested by multicultural educationists is that "a truly multicultural education would teach the histories, literatures, and contemporary experiences of "other Americans" as integral parts of the

curriculum" (Lustig, 1994). Such an approach is also endorsed by Hodson (1993) (among others) in the multicultural perspectives to be included in science education. Lustig investigated such an approach and found that the good-intentioned attempts at this actually had the opposite of the intended results. She concludes that superficial multicultural programs can be problematic and that multicultural education must be implemented intensively and systematically.

Hodson also warns us of a tokenistic approach. The problem is that we do not have evaluated examples of the difference between superficial and deep multicultural science education, especially in the third context I identified above. It may also be that an individual practitioner implementing multicultural science education needs to start with a superficial approach before moving to a deep approach. We simply do not know, or if we do, that knowledge needs to be shared.

Another common belief (hypothesis?) is that we need more role models of different ethnic backgrounds in schools and in the scientific enterprise. Pomeroy (1994) tells us that the value of role models is not generally disputed. Perhaps it is because teacher as role model is one of our cherished beliefs. The number of applicants to Faculties of Education who indicate they want to be role models is staggering. The notion of role model is actually quite complex and one wonders what role(s) these teachers are meant to be modelling. Indeed, while teachers may think of themselves as role models, it is highly possible that contemporary students do not see them in that way (Lim, 1999).

I could go on to provide other examples of the assumptions we have made that we have not validated empirically. Instead I would like to emphasize and endorse the contribution made by Atwater and Riley (1993) to our field by outlining a research agenda. I agree that the items they have listed are important, and research in those areas needs to continue. I would, however, argue strongly for the addition of evaluation of the implementation of multicultural science education strategies as part of that agenda.

Atwater and Riley tell us that "a body of knowledge about multicultural science education does exist, even though it may be scanty" (1993, p. 665). If we are looking forward in this "state of the art" exercise, then perhaps we could start with a collecting together of this body of knowledge (which I believe is no longer scanty) perhaps even under the headings outlined by Atwater and Riley. We would then be in a better position to see where we should direct further research effort, the conditions for which are currently more positive, I believe, than those outlined by Atwater and Riley.

In one of the studies that should be included in such a collection we find the following assertion:

For all children, learning science involves an assimilation to a Eurocentric/androcentric way of knowing and learning. For bilingual/bicultural students to be successful in the science classroom, they need to assimilate both linguistically and culturally to a white male dominated way of thinking and learning. (Barba, 1993, p. 1055).

If that assertion is true then we might as well give up the whole enterprise. I do not believe that any of us involved in the field of multicultural science education that take a culture studies perspective actually believe it to be true. We need to convince the others that there is another way. We need to provide the evidence that students can be successful in science without assimilating; acculturating or accomodating yes, assimilating no.

The difference is that one adds another culture, or learns it well enough to function within it, it does not mean replacing one's original culture, although there may be science educators that have that intent and certain curricular outcome statements could be interpreted that way. How successful such an approach may be has a lot to do with a student's identity (De Vos, 1995). The parallel can be made with learning another language.

Historically, immigrant (and colonized) students were expected to replace their mother tongue by English, a substitutive approach. Currently an additive approach is favoured, perhaps because research has shown cognitive advantages of bi/multilingualism (Lambert, 1975; Cummins, 1980). These advantages, however, are evident only when students do not have negative or ambivalent feelings towards these languages. Research could tell us how useful a parallel this is with learning the culture of science. Are students resistant when a substitutive approach is implicit in the science classroom?

Within a cultural studies perspective one talks about multiple identities. What must be avoided is the ascription of identities to students. One student I interviewed had been told by her history teacher that she was Afro-Canadian when in reality she was East-Indian/Trinidadian. To add Canadian to that mix was probably a little premature as she had only been in Canada three months. Because all of us have multiple identities, it is up to us to determine which is salient in any particular context. One of the shortcomings of the cultural studies perspective that focuses on the politics of identity is the presumption that gender/race/ethnicity/sexual orientation are always salient at any given time for any given individual. The advantage of culture studies in this context is the recognition that all of us are members of multiple (sub)cultures and that culture is always present. This has implications for the science classroom and research in multicultural science education to which I turn in the next and final section.

Putting the 'multi' back in multicultural science education

Earlier I referred to three contexts for multicultural science education. In this section I am referring specifically to the one in industrialized western contexts with students from various backgrounds. It is also this context in which the issue of assumptions is most critical. Much of the literature on multicultural education deals with specific contexts where one particular cultural group is a dominant minority (e.g. Rakow & Bermudez), the second context I identified above. Such contexts might better be referred to as bicultural. However, there are very few contexts where they reflect the actual demographics of urban classrooms in North America. While one or two cultural groups may be dominant, most, if not all classrooms, in such urban settings are multicultural. Even identifying students as Hispanic hides cultural variation within that group.

Such multicultural classrooms pose added challenges for teachers. While it is possible for teachers to become familiar with another culture other than one's own, to become familiar with twenty or thirty is impossible. In such contexts teachers cannot adjust content to meet and reflect the history of every group, a suggestion referred to earlier. Instead, they need to be explicit when talking about aspects of scientific culture that would/could be different from students' cultures. To reemphasize an earlier point, in order to help teachers deal with these demanding contexts we need to identify the variables that can cause cultural incongruence and difficulties in crossing the borders. We still do not have enough data to know which are the most salient.

That this is an important issue is illustrated by findings that show different teaching and learning contexts work for different cultural groups in learning to read (Jordan, 1985). How can teachers accomodate such different learning styles when there are a number of different cultural groups in one classroom. One approach may be to use a variety of approaches to address students' strengths and weaknesses at different times, allowing them experience in a variety of methods of learning. This is a hypothesis that needs to be empirically tested to see if it works, which brings me back to some of my earlier points. While we have come a long way in bicultural contexts, we have a long way to go in helping teachers in multicultural contexts other than suggesting ways that arise from our theoretical frameworks and intuitive hypotheses.

In conclusion, I would suggest that the testing of hypotheses and strategies in multicultural classrooms and a comprehensive review of the literature should be added as next steps in our research agenda.

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